Pre-Columbian American Sunflower and Maize Images in Indian Temples: Evidence of Contact between Civilizations in India and America

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Sculptured representations of sunflower heads and maize ears are found in ancient temples in India. These images relate to the Lord Siva and to Hindu sun worship and date from seven hundred to thirteen hundred years ago. The fact that these crops were domesticated only in America several thousand years earlier suggests that people were able to sail far enough to transport cultural items across the world's oceans, perhaps both the Atlantic and the Pacific.

The conventional belief system of many historians, anthropologists, and geographers holds that the high civilizations in the New World (such as the pre-Inca, Inca, Olmec, Maya, Toltec, and Aztec) developed without any significant contact with or transfer of cultural traits from the Old World.[1] However, ample field evidence of pre-Columbian cultural diffusion between the Neotropics and the Old World suggests a definite need to reconsider that belief. The diffusion hypothesis has been presented in multiple forms by many scholars.[2] For example, Betty J. Meggers, in her most recently published proposal for determining the presence or absence of cultural diffusion, points out that the chromosomes of living plant tissue that have been modified in the New World provide solid evidence for significant contact when those crops show up in Asia.[3] Such crops display the rational characteristics identified by Meggers as indicating diffusion. In the case of maize and sunflowers, it does not matter where they came from; rather, the important point is that these wild plants certainly were greatly changed by farmers in the Americas and taken to Asia in that changed state at an early date. Data presented in this chapter support a hypothesis that transoceanic voyagers carried American domesticated plants to India before the time of Columbus.

This study draws on evidence from temple carvings in India that depict the American crop plants maize (*Zea mays* L.) and sunflowers (*Helianthus annuus* L.). I have directly observed these crops and ancient sculptures of them, studied many photographs and literature citations, and interviewed epigraphers and archaeologists to test the diffusion hypothesis. In addition, I have carefully considered counterindications to diffusion. The fact that the conclusions of hundreds of other authors[4] who have written on the general topic of diffusion have been rejected one by one by traditional professionals continues to stimulate the search for incontrovertible biological evidence that would be impossible to be "independently invented" on the other continent an ocean away. This study shows that the highly detailed stone images of sunflower and maize in Indian temple carvings form a synergistic matrix in time and place that indicates that in this case diffusion across the oceans was highly probable in pre-Columbian times.

Evidence of Diffusion

The morphology of the crop plants represented in India's temple art is quite detailed. Indian temple complexes often are composed of buildings constructed of polymorphic stone blocks, and temples and walls in India, the eastern Mediterranean, the Maldives, Easter Island, and especially Peru display essentially the same external design of construction. Both New and Old World temples were used in the worship of the sun. The maize images and polymorphic-block temple form in India may have been related to Peru, but the sunflowers may have come from northwestern Mexico to the southeastern United States.

The genus of the sunflower is American and includes between sixty-eight and several hundred species (according to different authors). It has no wild representatives in any early Asian biota from which an Asian sunflower could have evolved.[5] No bird can fly across the Atlantic or Pacific Oceans carrying sunflower seeds in a viable condition in or on its body, and sunflower seeds cannot float even a short time in ocean water without being eaten or spoiled by the salt. The cultivated sunflower appears to have come from the central United States area, from where it spread widely. The question of how far it spread in pre-Columbian times may be more difficult to determine. For example, according to Oakes Ames, eighteenth-century Swedish botanist Carolus Linnaeus relegated sunflowers to Mexico and Peru,[6] and in 1976 Charles B. Heiser Jr. reported that many other scientists over the last couple of centuries believed that sunflowers were more widely spread in the Americas than he claimed was actually the case.[7] Apparently, none of the authorities recognized that transoceanic dispersal had occurred. I will return to this point later in this report. The sunflower was domesticated in eastern North America over fifteen hundred years ago. Space does not allow a full development of the question, but ultimately the possible sources of *Helianthus* should be examined closely.

Sunflowers and Solar Calendric Dating

Now that references to the sunflower in the early religious texts of India[8] appear to be verified by the flower's use in temple architecture, more concrete examples and study are needed to determine the broader significance of the presence of sunflowers (*surya kanti* in Sanskrit) in early Hindu sun worship. To date, little has been written about carvings depicting sunflowers in southern India; it is as if the art historians have not differentiated the sunflower from the lotus (*padma* in Sanskrit), except for Thor Heyerdahl's report of finding carvings of ancient sunflowers in the Maldive Islands southwest of India.[9] The Heyerdahl sunflower, however, may be a stylized symbol of the sun instead of a sunflower, because this sunflower consists of only three straight parallel lines radiating horizontally from a central circle (as far as I can find), as opposed to a series of petals radiating all the way around a circle, representing a sunflower head.

Because young sunflower heads turn early in the day to face the sun, the sunflower was an appropriate symbol for sunrise or sun worship because it integrated ritual elements important to the priests of Lord Siva: the horizon, the sunflower itself, Nandi (a statue of the bull, transport vehicle of Siva), and the Siva Lingam (a statue of the reproductive essence of Siva), which was placed deep inside the temple where its alignment provided a propitious observation point for the equinoxes. In India I first encountered maize and sunflower representations (the latter associated with dawn or sunset) in the Keshava Temple at Somnathpur, Karnataka. I found a further example inside the Keshava Temple at Halebid, Karnataka, where due east of the Siva Lingam a Nandi figure had a sunflower carved on each side of its head. Subsequently, I observed multiple sunflower carvings in temples with different relationships to the solar calendar.

The sunflower identified in the carving over Nandi's ear in the temple at Halebid has (1) seventeen ray (petal) flowers carved so that every second petal is overlapped, (2) a large diameter, (3) a very gently rounded seed head

in the center of the flower, and (4) a narrow, raised ring just inside the ray flowers that clearly represents the stigmas, styles, and stamens of the first florets that will develop the first mature seeds at the outside of the seed head in real sunflowers. These florets develop within a day or two of the unfolding of the ray flowers.

At Halebid during the equinox, a significant universal date for priestly astronomers, the dawn sun shines over a low-relief, distant horizon, past the notch between the left horn of Nandi and the sun-seeking sunflower positioned below it and above the ear, and in through the temple until it finally illuminates the Siva Lingam at the center of the inner *sanctum-sanctorum*. The sculptured sunflower is 16 centimeters across, its ray flowers 3.5 to 3.75 centimeters long. A central disk is 7 centimeters across, and the ridge ring just inside the ray flowers is 1 centimeter in width. Some present-day sunflowers in India have approximately the same relationship of size and shape (see fig. 1).

It might be suggested that another flower is represented here, but the large, gently domed seed head shown is not characteristic of the small-centered lotus flower (*Nelumbo* sp.) or the water lily *(Nymphaea)*, and the lotus blossoms have been sculpted in a shape quite different from the sunflower. Normally the lotus symbol in these temples has two and sometimes three rows of petals, and each outer row is longer than the inner row. Its seed head is also proportionately smaller than the sunflower and regularly has no raised ring on the seed head. In both species the petals tend to alternate, with full petals overlapping the tips of petals of the same length. Rarely are the characteristics of each species shared, such as a ring on the lotus flower; the majority of the distributions leave no doubt of the species involved. In any case, sunflowers were placed where solar light was ritually significant for the worshipers.

In at least five locations in India the sunflower is associated with Siva's bull, Nandi. The Hindu priests at these sites are aware that Nandi is located where the dawn's rays will pass over the bull figure at two periods during the year and illuminate the Siva Lingam inside the *sanctum-sanctorum* of the temple for a few minutes at dawn on only a few of these days.

At the Amruthteshvara Temple in the town of Amruthapura, Karnataka, the dawn sun rays pass between Nandi's two horns to illuminate the Siva Lingam on the eighth of February each year. Here, however, the sunflowers on Nandi that are carved just under the horns and above the ears do not protrude from the sides of the head (see fig. 2), so there is no major ear/sunflower notch for dawn sunlight as on the Nandi figure at Halebid. At Amruthteshvara the Nandi figure is oriented so that dawn light shines between Nandi's horns. Thus it is obvious that the sunflower is purposefully placed on the sculpted image in relation to the solar phenomena being observed or commemorated. In the Amruthteshvara Temple the azimuthal bearing of the gap between the temple's central colonnade provides barrier controls for the entry of the dawn sunlight. This colonnade is oriented twenty to twenty-three degrees south of due east. The orientation of this temple allows light to enter from 5 to 12 February. The solar significance of the central date of 8 February is that it is halfway between the winter solstice and the spring equinox.[10]

Just 240 kilometers east of Amruthteshvara, at Bangalore, Karnataka, the incredibly complex cave temple called Sri Gave Ganadeshvara demonstrates the concern in ancient Hindu culture for obtaining solar calendric dating. The underground granite cave is cut to form a temple and maze into which the sunset rays enter only by passing over the top of a set of buildings, across a roadway, through a three-meter-high arch perched atop a boundary wall of the temple (the arch is designed only for the passage of light, not people or animals; see fig. 3), across the entryway of an open compound, through a window, across an outer room, through another window, across the main meeting room in front of Nandi, over Nandi's horns, through a doorway that has a sunflower carved on the

first doorsill, and finally through a small anteroom and across another sill with a lotus carved on it. The rays then illuminate the Siva Lingam inside the inner sanctum on the evening of a single day, 14 January (marking approximately one-fourth of the period between winter solstice and spring equinox), to start the *Makrama Sankramana* (or *Makra Sankrante*) week of ceremonies. Another distinct lotus image, with its multiple rings of petals, is carved on the doorsill of the entrance to the main worship room and serves as a comparison to the sunflower on the other sill. The lotuses on the sills have relatively long petals and a very small, flat, circular center without the outer raised ring. The sunflower on the inner sill, however, has much shorter petals and a large, smooth, slightly mounded circular center with the small, raised ring between the central disc and the ray flowers.

A bearing of approximately nineteen degrees south of due west allows the near-sunset sunlight on 14 January at about 4:30 to 5:00 to descend more than three meters below the entrance walkway and down into the cave temple. The cessation of sunlight inside the cave signals the end of the opening ceremony as well as the beginning and, a week later, the ending of *Makrama Sankramana*, perhaps the most important Hindu religious period of the year in this part of southern India.

These complex architectural alignments obviously betoken the high degree to which the sunflower has been integrated into the ritual configuration of the Siva cult. It would be absurd to suppose that this association of flower, calendric sun angle, and temple architecture could have been achieved in less time than many centuries.

In southern India small Nandis with a sunflower on each side of the head or on the forehead have been found oriented to the sun in front of Siva Lingams at the following locations: the Virupaksha Temple in Bhatkal, Karnataka; the museum of Halebid; Bhagavatti (near Karwar), Karnataka;[11] and in a few other places in Karnataka.

The aforementioned giant arch on the temple wall at Sri Gave Ganadeshvara has another relation to the sunflower. At dusk on the equinoxes, the cusp on the uppermost design of the arch allows light to shine along the front of the temple and onto a large sunflower image sculpted and painted on the west-facing courtyard wall overlooking the temple (see fig. 3). This flower, located due east of the center of the arch, has a large, smooth center (see fig. 4). The surrounding ring represents the flower's stigmas, styles, and stamens. In addition, a single set of petals outside the ring allows us to classify the flower as a sunflower facing sunset.

The very large "equinox" Nandi in the temple at Halebid is highly distinctive because it is the only one known to have several sunflowers under the tail. Each small flower is seven centimeters in diameter and is carved on each side of the stone support for the bull's tail (see fig. 5). According to the priests, on the equinox six of the seven sunflowers tend to be in the shadow of the tail above them, whereas for a couple of days before and after the equinox they are a bit illuminated by the sun on either the north or south side, depending on whether it is spring or autumn. A few days before the solstices, the dawn lights the sunflowers entirely on the north or south side of the tail, depending on whether it is the winter or summer solstice. Thus, on the basis of this phenomenon the Hindu priests of the Keshava Temple at Halebid could know, a few days in advance, how close the dawn sun was to the equinox or solstice date. This knowledge became critical in determining the actual day of the equinox in the event of cloudy weather that obscured dawn's light on the equinox.

In the Mallikarjuna Temple at Pattadakal, Karnataka State, a representation of a dried, mature sunflower seed head is carved on a column in extended bas-relief. An Indian parrot is perched on the edge of the seed head as if it has just eaten the missing sunflower seeds on the edge of the seed head and is about to eat more seeds (see fig. 6).

The bottom of dried sunflower heads indent as they dry out, as shown in figure 6, although the design may be somewhat stylized for sculpturing purposes.

In sun temples (those with special solar orientation) such as those found in Ellora and in the Ajanta cave complexes of temples in Maharashtra State, the sunflower design appears in about one in ten of the plaques in the sculptured ceilings. The square-shaped sunflower plaques are interspersed with plaques of lotus of similar shape. These images are in ceiling frescoes considered to have been made more than two thousand years ago. The flowers are somewhat inconsistent in design, but those that are sunflowerlike have the ring surrounding the seed head and only one set of petals. This clearly indicates that the sculptors' model for the sunflower was picked only a day after the sunflower opened. (I have carefully observed this ring phenomenon on sunflowers on my farm in Oregon.)

Dr. Madhav N. Katti, chief epigrapher at the Indian Archaeological Survey, helped in the discovery of sunflowers at the feet of the sculptured stone goddesses at Somnathpur. These several sunflower images at ground level may indicate the proper time of making offerings of corn (maize) at the many Hoysala dynasty (AD 1000–1268) temples that use the symbol. Figures 7 and 8 illustrate the appearance of these sunflower images.

Literary evidence has been interpreted as supporting the identification of sunflowers in these temples. Dr. Katti's colleague, Dr. Shitala P. Tewari, showed my group his translations of the Sanskrit term *ashtapuspika*, which literally means "eight flowers" and can also refer to eight (or multiples of eight) parted flowers. He acknowledges that at least one of the translations for *ashtapuspika* in the religious literature is "sunflower," now commonly called *surya kanti* ("sun flower," that flower attracted to the sun).[12] Furthermore, the Tagare group's translation of the fifth-century *Bagavata Purana* interprets the Sanskrit word *arka* to mean "the sun plant" (sunflower) or "sun."[13]

None of the authors who have recently published on the cpDNA analysis of *Helianthus annuus* have recognized that the location of the plots of Chinese sunflower DNA lie on the graph beyond the bounds of what would normally be considered to be the same population source.[14] In the American distributions of sunflower DNA, the separation of the New World wild and domesticated sunflowers is shown to be so different from the Chinese (Russian and Turkish) sunflower DNA that this difference should have called into question the assumptions concerning the antiquity of races of sunflowers in Asia, but apparently this important point has been overlooked. If, as is indicated by the findings in this paper, sunflowers were in the Old World—especially in China and India—for more than one or two millennia, then we might expect some reasonable amount of genetic drift to have occurred. We do in fact find evidence of genetic drift in their DNA distributions: the seed cases of the sunflower fruits in China are significantly longer than those in most of the materials from early North American forms. This difference in the Chinese material can easily be hypothesized as being the result of the Chinese having selected for long seed cases, whereas the North American peoples may have been selecting for more seeds, more oil, more dye, different color, and so on. This evidence supports my postulation that significantly early cultural contact occurred between the New World and the Asian mainland, that this accounts for the presence of sunflowers in Asia in pre-Columbian times, and that once there the crop spread widely.

In summary, to be viable upon arrival in India, sunflower seeds had to have been carried across the sea in a dry place, perhaps stored on ships as long-term rations for voyaging. A complex set of iconographic data demonstrates that priests, planners, and artists engaged in constructing and utilizing the many sun temples in Karnataka State had live specimens of sunflowers available. These people incorporated the unique sun-seeking behavior of sunflowers purposefully into the Siva cult and its architecture no later than the tenth century and probably long before.

Maize

The discoveries of ancient, excellently carved stone sculptures of American maize (*Zea mays* L., the same types grown in America one thousand years ago) in India in most, if not all, of sixty Hoysala dynasty temples are now well documented.[15] The evidence for pre-Columbian maize in Europe, Africa, and China has also been published.[16] However, despite the research demonstrating the presence of maize in sixth- to thirteenth-century temples at Amruthapura, Arsikere, Badami, Belur, Baindoor, Halebid, Harnahalli, Javagal, Nuggihalli, Somnathpur, Sravana Belagola, and sixty other temple sites in Karnataka (see fig. 9), many ethnobiologists have assumed that maize could not be a valid interpretation. Some who disagree have argued that the maize sculptures actually represent pomegranates (see fig. 10), upside-down cornucopia, or silk purses with cowry shells or pearls stitched on. However, the maize ears clearly do not have the placentas of the pomegranate, and the kernels do not have the proper shape and arrangement to be anything but maize.

The precise, intricate morphology of the sculpted ears normally shows the kernels arranged in pairs, with two kernels per cupule (see fig. 11). Just as in the natural world, this pairing is not always regular, and occasional shifts are found in the arrangement of the kernels. In the temple art the rows of kernels may be straight (see fig. 12), gently spiraling (see fig. 13), tightly spiraling or tessellated at the base (see fig. 14) or tip only, or tessellated throughout.

When the ears are shown in the husk, they are sometimes smooth, as if the silks had been pulled off, or they sometimes have the silks symbolized as an etched pair of curls on the husk (see fig. 15). Three times or more the curl of silk has subcurls on the larger curl, just the way one finds it in real maize ears when the ears still have their husks. Geographer Greg Howard suggests that this sculptural detail of silk on the ears is compelling evidence for the presence of maize plants in India, the live ears of which were used as models in sculpture. Occasionally the kernels are pointed and imbricated, though normally they are rounded as most flint and flour-starch kernels are. The width-to-thickness ratios for the kernels in the images (1:1.0 to 1:2.0, with the mode, or most frequent ratio, being 1:1.3) are approximately the same as in archaeological maize one thousand years ago from the Americas.[17] The size of the kernels in nature depends on their location on the ear and whether they have been pollinated. In the sculptures, smaller kernels usually appear near the ear's tip, and what would be unfertilized kernels are carved as smooth surfaces at the tip. Unfertilized kernels sometimes occur when the silks fail to protrude from the husk on one side of the ear. A thirteenth-century sculptor depicted that reality by sculpting a maize ear with two rows of mature kernels, four rows immature kernels, and a third of the husk removed to show all this.[18] Nothing but an actual ear of this shape could have inspired this sculptor to capture such details!

In Temple Cave III at Badami, Karnataka, we find another example of realistic modeling. In one of the oldest (sixth century AD) carved maize ears discovered so far, a bit of the stem protrudes from the base of the ear because the ear is held horizontally in Vishnu's hand rather than held with the base in the palm of the hand, covering the stem, as in all other sculptures (see fig. 16). Moreover, in the sculptures of seven hundred to nine hundred years ago, the maize ears often have warped, bent tips (see fig. 17), a detail supported by the fact that in nature even at present the antique varieties of maize ears grow and dry that way 5 to 10 percent of the time.[19]

In a 1990 study John Doebley was convinced that maize was not in Europe before the time of Columbus,[20] but he overlooked Carl O. Sauer's earlier study that proves that maize was in Italy (in Milan and Lombardy) and Spain (in Granada) before 1492.[21] Recent scholarship continues to provide evidence supporting the presence of maize in the Old World. Gunnar Thompson's 1997 study expands greatly on the evidence for the early presence of maize in

the Mediterranean region. His illustration of a ceramic sculptural representation of maize in China is also a modestly good example of maize in the Old World, showing layers of husks attached to the base of the ear; but it is idiosyncratic and is not an absolutely identifiable reproduction.[22] In England's Rosslyn Chapel is a sculpted motif, made decades before Columbus, featuring what appears to be maize, though this motif lacks the intricate detail and perfection of the stone carvings found in Hoysala dynasty temples.[23] From what I have seen, the sculptures of India's Hoysala dynasty come closer than Aztec sculptures in the New World come to representing maize.

The intricacy and completeness of maize-ear morphology represented in India's stone images leads inevitably to the conclusion that the sculptors had real models of maize ears on hand. Actual maize plants must have been growing in India.

It follows that maize must have been introduced into India from America, for virtually all botanists agree that it was native in America. Maize ears represented in the Hoysala temples often have characteristics similar to Peruvian maizes. Many of these Peruvian forms, which have relatively primitive characteristics typical of the ancient genetic maize variations pointed out by Zeven and Zhukovsky,[24] were taken from Peru to Central America and Mexico. Once there, they cross-pollinated with the original maizes of Mexico and Central America to create the races of maize we find there today. The frequency and distributions of the knobs that show on the stained chromosomes of maize in Peru and Central America can be explained by the acceptance of these translocations of South American forms of maize.[25]

The waxy-starch maize (*Zea certina* Collins) was a mutant in the Americas but was selected as a variety in Asia, similar to the way waxy wheat, barley, rice, foxtail millet, and sorghum had been selected for their consumption in Asia.[26]

Where is the gene pool of the early maize population that served the sculptors of India? Most likely it is in the fields of the Hill Tribes (the minority groups) of India. The search for the gene pool is in the future, as is the search for maize phytoliths under the one thousand-year-old buildings. In addition, the case for diffusion is strengthened when sculptures of American sunflowers and maize are found in India in buildings of the late Chalukyan culture (AD 1000–1200) that are homologous to distinctive buildings of cultures in the pre-Columbian Andes of South America of about the same age.

Polymorphic-Block and Massive-Stone Architecture

Early sun temples found in Karnataka State and in the eastern Mediterranean countries were built with massive polygonal stone blocks of approximately the same horizontal thickness throughout their length. The walls were built without mortar, but because of their stepped ends, the blocks interlock and tend to stay in place. Frequently in Karnataka's polymorphic-stone construction, walls surround or form the base of the temples, and the sun temples themselves are located in the same sacred complexes where we find the maize and sunflower sculptures of the Hoysala dynasty, which spanned the eleventh through the thirteenth centuries AD (see fig. 18). Some of these temples and some of their walls have essentially the same distinctive system of construction as that found in many pre-Inca and Inca temples, as well as in city walls, temples, and houses in the Andes from pre-Spanish times.[27] The most famous locations are near Cuzco, Peru, but this type of construction extends through many parts of the ancient realm of the Incas (see fig. 19).

This construction involves the use of blocks of shaped stone. They do not necessarily have corners cut at ninety-degree angles, nor are their tops, bottoms, and end surfaces always parallel. The sides are parallel and similar in size, and the blocks are closely and intricately fitted together despite their lack of parallelism. No mortar was used on either continent with this type of construction. Frequently more than four surfaces touch because of the irregular shape of the blocks, which feature stair-step-like ends and many different angles. These large blocks commonly had either four protruding knobs or four small holes near the bottom of the sides that enabled them to be lifted (by ropes alone or by ropes with metal hooks) and maneuvered to fit with the blocks already on the rising wall. In both Peru and India the knobs at the bottom of the blocks, both inside and outside the building, were often left protruding. The masons doing the construction often did not retouch the surface of the walls after the stone units were supplied by the stone cutters and sculptors and put in place.

In Peru the masons who assembled the buildings sometimes ground the blocks together for a tighter fit, a detail I observed at the Temple of the Sun in Cuzco. The modestly sized blocks of a curved wall at the side of that temple apparently were swung by their knobs or hook holes into position for finish grinding using an A-frame. Each block was swung back and forth across the wall until the grinding motion created a convex surface on the bottom of the swinging block and a slightly concave surface on the top of the block already in the wall. Blocks were fitted together as they were stacked. So far I have not found this arcuate grinding used on the Indian subcontinent. In India the horizontal surfaces of the blocks appear to be flat, wherever I have been able to observe them. Modern stone masons in India always use iron chisels and hammers, and when shown photos of the South American work, they claim it would have been impossible to have cut granite in Peru on a large scale without iron chisels. Scientists need to think about that.

The construction system in both the New and the Old World incorporated bas-relief decorations on the sides of the walls, especially near the doorways of the polymorphic-block buildings. These ornaments included fish, snakes, turtles, or tenoned heads of other animals. The canons of construction allowed decorative carvings on door jambs and round, lathe-turned columns inside the temples, especially in India, but they are also reported near the coast in Peru.

In this type of polymorphic construction in Egypt, Greece, Anatolia, Spain, India, and the Andes, often the corner blocks and sometimes the wall blocks of the buildings are held together with metal bars. These bars, shaped like inverted staples or like *Is* and butterfly (abutting) triangles, lock into holes of the respective shapes and notches in the tops of the stone blocks. In India and in zones of high earthquake stress (in Peru, for example), iron, silver, bronze, and perhaps wood were used to make the fasteners that hold the mortarless blocks in place. Aspects of this general polymorphic construction are also found in slightly modified forms on Easter Island, in the Maldives, in the Indian Ocean, and in various other Old World cultural hearths.[28]

Peruvian features not found in the Old World are the beveled outer surfaces of the edge of the blocks on some Incan walls; the beveled, round corners; and the much larger blocks with curvilinear sides that were fitted smoothly together. It is possible that some of these specialized features were developed late in Inca times—too late to have been known to transoceanic travelers of an earlier day—or perhaps they have not been recognized in the Mediterranean area.

Conclusions

Aspects of ancient architecture in India and in the New World that exhibit a significant degree of correlation include (1) the polymorphic mode of construction at sites consecrated to sun worship and whose buildings have a

solar orientation at dawn or dusk on specific dates, (2) animate decorations, (3) the metal clamping mechanisms that help hold those buildings together, and (4) especially the carvings of plants of American origin that were integrated into the local religious life and building decoration. This evidence compels us to see transoceanic contact and cultural diffusion, not independent invention, as the explanation.

The ability of Old and New World people to sail across the world's oceans is another major topic that has been amply demonstrated by several authors, although space does not permit its full documentation here.[29] According to these authors, the somewhat restricted fashions of rafts and ships in the New World are all represented in watercraft of the Old World, which are more diverse in size, shape, gear, and use. The literature cited demonstrates beyond question that transoceanic travel by rafts and ships was entirely feasible in periods of time that could account for the transmission of maize and the sunflower, which were surely used as models by the sculptors of the Karnataka State area.

The results of my personal investigation of sunflowers, maize, and building construction, in addition to my review of the bibliographic citations of many hundreds of other reports on diffusion (or its lack) assembled by John L. Sorenson and Martin H. Raish,[30] indicate contact between Asia and the Americas prior to European intrusion in AD 1492. The crop models of American sunflowers and maize ears for the sculpted stone images in India surely came from the Americas, most likely either Mexico, Central America, or the Andes, and perhaps Amazonia, where they were present many centuries ago. The polymorphic blocks used in several structures in India that exhibit these plants are similar to Peruvian stone structures and indicate significant contact between Asia and the Americas before AD 1000. It is time to recognize that many cultural traits and biological organisms diffused across the ocean earlier than the Iberian discoveries and transfers in the late fifteenth and sixteenth centuries.

Notes

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1. See Gordon D. Gibson, "The Probability of Numerous Independent Inventions," *American Anthropologist* 50 (1948): 362–4; David M. Pendergast, "Further Data on Pacific Coast Fired Clay Figurines," *American Antiquity* 23 (1957): 178–80; John H. Rowe, "Diffusionism and Archaeology," *American Antiquity* 31 (1966): 334–7; Barbara Pickersgill, "Cultivated Plants as Evidence for Cultural Contacts," *American*

Antiquity 37 (1972): 97–104; Zena Pearlstone, “Sujang: A Stirrup Spout Vessel from Nigeria,” *American Antiquity* 38/4 (1973): 482–6; Juan Comas, *Origen de las culturas precolombinas* (Mexico: Universidad Autónoma de México, Instituto de Investigaciones Antropológicas, 1975), 175; Frank J. Frost, “Voyages of the Imagination,” *Archaeology* 46/2 (1993): 44–51; O. Silva Galdames, *Prehistoria de América,* 3rd ed. (Santiago, Chile: Editorial Universitaria, 1977); George Kubler, *The Art and Architecture of Ancient America: The Mexican, Maya and Andean Peoples,* 3rd ed. (Baltimore: Penguin, 1984); Paul C. Mangelsdorf and Douglas L. Oliver, “Whence Came Maize to Asia?” *Harvard University Botanical Museum Leaflets* 14/10 (1951): 263–91; Alan J. Osborn, “Limitations of the Diffusionist Approach: Evolutionary Ecology and Shell-Tempered Ceramics,” in *The Transfer and Transformation of Ideas and Material Culture,* ed. Peter J. Hugill and D. Bruce Dickson (College Station: Texas A&M University Press, 1988), 23–44; John Doebley, “Molecular Evidence and the Evolution of Maize,” in *New Perspectives on the Origin and Evolution of New World Domesticated Plants,* ed. Peter K. Bretting, (Lawrence, Kans.: Allen Press, 1990), 6–27 (supplement to *Economic Botany* 44/3 [1990]); and Jeffrey Quilter et al., “Subsistence Economy of El Paraíso, an Early Peruvian Site,” *Science* 251 (January 1991): 277–83.

2. See George F. Carter, “Pre-Columbian Chickens in America,” in *Man across the Sea: Problems of Pre-Columbian Contacts,* ed. Carroll L. Riley et al. (Austin: University of Texas Press, 1971), 178–218; George F. Carter, “Domesticates as Artifacts,” in *The Human Mirror: Material and Spatial Images of Man,* ed. Miles Richardson (Baton Rouge: Louisiana State Press, 1974), 201–30; Eugene R. Fingerhut, *Explorers of Pre-Columbian America? The Diffusionist-Inventionist Controversy* (Claremont, Calif.: Regina Books, 1994); James A. Ford, *A Comparison of Formative Cultures in the Americas: Diffusion or the Psychotic Unity of Man* (Washington, D.C.: Smithsonian Institution, 1969), 1–211, especially 188–94; Stephen C. Jett, “Diffusion versus Independent Development: The Bases of Controversy,” in *Man across the Sea,* ed. Riley et al., 5–53; Carl L. Johannessen, “Folk Medicine Uses of Melanotic Asiatic Chickens as Evidence of Early Diffusion to the New World,” *Social Science and Medicine* 15 (1981): 427–34; Carl L. Johannessen, “Melanotic Chicken Use and Chinese Traits in Guatemala,” *Revista de Historia de América* 93 (1982): 73–89; Carl L. Johannessen and Anne Z. Parker, “Maize Ears Sculpted in Twelfth and Thirteenth Century AD India as Indicators of Pre-Columbian Diffusion,” *Economic Botany* 43 (1989): 164–80; John L. Sorenson and Martin H. Raish, *Pre-Columbian Contact with the Americas across the Oceans: An Annotated Bibliography,* 2 vols. (Provo, Utah: Research Press, 1990); C. R. Stonor and Edgar Anderson, “Maize among the Hill Peoples of Assam,” *Annals of the Missouri Botanical Garden* 36 (1949): 355–404; Gunnar Thompson, *American Discovery: Our Multicultural Heritage* (Seattle: Argonauts Misty Isle Press, 1994); Gunnar Thompson, “Seeds of Paradise: Maize Diffusion before Columbus,” *Ancient American* 19/20 (1997): 64–71.
3. See Betty J. Meggers, “The Transpacific Origin of Mesoamerican Civilization: A Preliminary Review of the Evidence and Its Theoretical Implications,” *New England Antiquitities Research Association Journal* 31/1 (1997): 6–25.
4. For an exhaustive listing of the published works of these diffusionist authors, see Sorenson and Raish, *Pre-Columbian Contact.*
5. See Oakes Ames, *Economic Annuals and Human Cultures* (Cambridge, Mass.: Botanical Museum of Harvard University, 1939), 90; Edgar Anderson, *Plants, Man, and Life* (Berkeley: University of California Press, 1952), 164–74; Charles B. Heiser Jr., “The Origin and Development of the Cultivated Sunflower,” *American Biology Teacher* 17 (1955): 161–7; Charles B. Heiser Jr., *The Sunflower* (Norman: University of Oklahoma, 1976), 32, 34, 35, 45, 110; Richard A. Yarnell, “Native Plant Husbandry North of Mexico,” in *Origins of Agriculture,* ed. Charles A. Reed (The Hague: Mouton, 1977), 861–4; and A. C. Zeven and P. M. Zhukovsky, *Dictionary of Cultivated Plants and Their Centres of Diversity: Excluding Ornamentals,*

Forest Trees, and Lower Plants (Wageningen, the Netherlands: Centre for Agricultural Publishing and Documentation, 1975), 130, 173–4.

6. See Ames, *Economic Annuals,* 90.
7. See Heiser, *Sunflower,* 50, 53–4.
8. See Shitala P. Tewari, *Contributions of Sanskrit Inscriptions to Lexicography* (Delhi, India: Agam Kala Prakashan, 1987); and Carl L. Johannessen and Anne Z. Parker, "American Crop Plants in Asia prior to European Contact," *Yearbook 1988: Proceedings of the Conference of Latin American Geographers* 14 (1988): 14–19, especially p. 17.
9. See Thor Heyerdahl, *Early Man and the Ocean: A Search for the Beginnings of Navigation and Seaborne Civilizations* (Garden City, N. Y.: Doubleday, 1979), 67, 68, 84, 94, 108–9; and his *The Maldive Mystery* (Bethesda, Md.: Adler and Adler, 1986), 88 passim, 248–9.
0. This point was brought to my attention by Professor Fred Hirsch, a geographer in Oregon.
1. Here the Nandi figure is located outside without a roof, and the Siva Lingam stands in the ground.
2. See Tewari, *Sanskrit Inscriptions.*
3. See Johannessen and Parker, "American Crop Plants in Asia," 17.
4. See D. M. Airas and Loren H. Rieseberg, "Genetic Relationships among Domesticated and Wild Sunflower (*Helianthus annuus,* Asteraceae)," *Economic Botany* 49/3 (1995): 243–5; Loren H. Rieseberg and Gerald J. Seiler, "Molecular Evidence and the Origin and Development of the Domesticated Sunflower (*Helianthus annuus,* Asteraceae)," in *New Perspectives,* ed. Bretting, 83; and Peter K. Bretting, "New Perspectives on the Origin and Evolution of New World Domesticated Plants: Introduction," in *New Perspectives,* ed. Bretting, 3.
5. See my chapter "Maize Diffused to India before Columbus Came to America," in my *Across before Columbus* (NEARA [New England Antiquities Research Association], forthcoming); and Johannessen and Parker, "Maize Ears Sculpted in Twelfth and Thirteenth Century AD India," 165–74 (see n. 2). As illustrated in these two sources, Hoysala dynasty sculpture in India is, in accuracy of detail, equal to or better than the pottery in the early Americas. See Alan C. Lapiner, *Suns, Gods, and Saints* (New York: Andre Emmerich, 1969), fig. 36; and Julia Jones, *Art of Empire: The Inca of Peru* (New York: Museum of Art, 1964), figs. 58, 59. The majority of Indian sculptures show maize more accurately than the first European illustration of maize by Leonhart Fuchs in *De Historia Stirpium Commentarii Insignes* (1542). Fuchs's illustration appears in Herbert G. Baker, *Plants and Civilization,* 2nd ed. (Belmont, Calif.: Wadsworth, 1970), 74.
6. See Carl O. Sauer, "Maize into Europe," *Akten des 34. Internationalen Amerikanisten Kongresses* (Vienna, 1960); reprinted in his *Seeds, Spades, Hearths, and Herds: The Domestication of Animals and Foodstuffs,* 2nd ed. (Cambridge, Mass.: M.I.T. Press, 1972), 147–67; M. D. W. Jeffreys, "Pre-Columbian Maize in the Philippines," *South African Journal of Science* 61 (1965): 5–10; M. D. W. Jeffreys, "Pre-Columbian Maize in Asia," in *Man across the Sea,* ed. Riley et al., 376–400; Tomasz Marszewski, "The Problem of the Introduction of 'Primitive' Maize into South-East Asia, Part II," *Folia Orientalia* 19 (1978): 127–63; and Edgar Anderson, *Plants, Man, and Life,* 139, 186 (see n. 5).
7. See Paul C. Mangelsdorf and C. E. Smith, "New Archaeological Evidence on Evolution in Maize," *Harvard University Botanical Museum Leaflets* 13 (1949): 213–47; and Johannessen and Parker, "Maize Ears Sculpted in Twelfth and Thirteenth Century AD India."
8. See Johannessen and Parker, "Maize Ears Sculpted in Twelfth and Thirteenth Century AD India," 172, fig. 12.
9. This tendency of some ears to develop bent tips can be viewed in the corn collection in the herbarium at the University of Wisconsin-Madison or in any other extensive collection that has not been selected against such morphology.

0. See John Doebley, “Molecular Evidence and the Evolution of Maize,” 7 (see n. 1).
1. See Sauer, “Maize into Europe”; reprinted in his *Agricultural Origins and Dispersals: The Domestication of Animals and Foodstuffs* (Cambridge, Mass.: M.I.T. Press, 1969), 147–67, especially 156–7.
2. See Gunnar Thompson, “Seeds of Paradise,” 64–6 (see n. 2).
3. See Andrew Sinclair, *The Sword and the Grail: Of the Grail and the Templars and a True Discovery of America* (New York, N.Y.: Crown, 1992), plate 23, bottom left, of the unpaginated illustration section.
4. See Zeven and Zhukovsky, *Dictionary of Cultivated Plants,* 150, 166–7 (see n. 4).
5. These knobs are described in Paul C. Mangelsdorf, *Corn: Its Origin, Evolution, and Improvement* (Cambridge: Harvard University Press, 1974), 28, 118–20.
6. See Zeven and Zhukovsky, *Dictionary of Cultivated Plants,* 33.
7. For detailed descriptions of this kind of construction in the New World, see George Bankes, *Peru before Pizarro* (Oxford: Phaidon, 1977), 127, 135, 185–95; Louis Baudin, Daily Life in Peru under the Last Inca, trans. Winifred Bradford (Oxford: Phaidon, 1977), 81, 96–7, 177; Hiram Bingham, “In the Wonderland of Peru,” *National Geographic* 24/4 (April 1913): 416–18, 462–71, 488, 502–9, 529–30, 551; John Hemming, *Machu Picchu* (New York: Newsweek, 1981), 172, especially 23–32, 44–5, 60–1; Gérard Nicolini, *The Ancient Spaniards* (Farnsborough, Eng.: Saxon House, 1974), 92–3; J. Alden Mason, *The Ancient Civilizations of Peru* (Harmondsworth, Middlesex, England: Penguin, 1968), 144–8, 163–4; Thor Heyerdahl, A*merican Indians in the Pacific: The Theory behind the Kon-Tiki Expedition* (London: George Allen and Unwin, 1952); Arthur Posnansky, *Tiahuanacu: The Cradle of American Man,* trans. James F. Shearer (New York: J. J. Augustin, 1945); Jean-Pierre Protzen, *Inca Architecture and Construction at Ollantaytambo* (New York: Oxford University Press, 1993), 82–7, 222–37, 251–9; Ronald Wright, *Cut Stones and Crossroads: A Journey in the Two Worlds of Peru* (New York: Viking Press, 1984); and Luis E. Valcárcel and Pierre Verger (photographer), *Indians of Peru* (New York: Pocahontas Press, 1950), photos 1–6.
8. See Jean-Pierre Adam, *Roman Building: Materials and Techniques* (Bloomington: Indiana University Press, 1994), 48–58; Somers Clarke and Reginald Englebach, *Ancient Egyptian Masonry* (London: Oxford University Press, 1930), 96–116 (but these authors say Egyptians used thin mortar between blocks); Graziano Gasparini and Luise Margolies, *Inca Architecture,* trans. Patricia J. Lyon (Bloomington: Indiana University Press, 1980), 284–9, 324–32, figs. 316–24; Giuseppe Lugli, *La tecnica edilizia Romana, con partícolare riguardo a Roma e Lazio,* 2 vols. (Rome: G. Bardi, 1957), especially 2:i–xxii; Thor Heyerdahl, *Sea Routes to Polynesia* (Chicago: Rand McNally, 1968), 7–232, especially 160, 165–6, 190, 193, 195; Heyerdahl, *American Indians in the Pacific;* Heyerdahl, *Early Man and the Ocean* (see n. 8); Sindigi Rajasekhara, *Early Chalukya Art at Aihole* (New Delhi: Vikas, 1985); and Richard A. Tomlinson, *Greek Architecture,* ed. J. H. Betts (Bristol, Eng.: Bristol Classical Press, 1989), 22.
9. See, for example, Edwin Doran Jr., “The Sailing Raft as a Great Tradition,” in *Man across the Sea,* ed. Riley et al., 115–38; Clinton R. Edwards, *Aboriginal Watercraft on the Pacific Coast of South America* (Berkeley: University of California Press, 1965); Heyerdahl, *Kon-Tiki: Across the Pacific by Raft,* trans. F. H. Lyon (Chicago: Rand McNally, 1950), 408, fig. xvii; Thor Heyerdahl, “Voyage of Ra II,” *National Geographic* 139/1 (1971): 44–71; Heyerdahl, *Early Man and the Ocean,* 20–5, 37, 204–15; Ling Shun-Shng, “Formosan Sea-Going Raft and Its Origin in Ancient China,” *Bulletin of the Institute of Ethnology* 1 (1956): 25–54; Betty J. Meggers, “Yes If by Land, No If by Sea: The Double Standard in Interpreting Cultural Similarities,” *American Anthropologist* 78 (1976): 637–9; and James G. Nelson, “The Geography of the Balsa,” *American Neptune* 21 (1961): 157–95.
0. See Sorenson and Raish, *Pre-Columbian Contact* (see n. 2).